What is claimed is:

1. An optical signal converter for use in optical code division multiplexing based on a binary phase optical code, comprising:

a grating waveguide having an identical number of uniform pitch gratings to the number of code chips of the binary phase optical code, said uniform pitch gratings being formed in a waveguide direction to reflect light of a predetermined wavelength,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the light of the predetermined wavelength, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the light of the predetermined wavelength.

2. An optical signal converter according to claim 1, wherein the spacing of said uniform pitch gratings is determined such that said uniform pitch gratings provide substantially constant light propagation delay time differences.

3. An optical signal converter according to claim 1, wherein at least one of said uniform pitch gratings is an apodized grating.

4. An optical signal converter according to claim 1, wherein at least one of said adjacent uniform pitch gratings corresponding to a position at which the optical code value change is an apodized grating.

5. An optical signal converter according to claim 1, wherein said uniform pitch gratings have one of a sinusoidal, rectangular and triangular refractive index profiles.

6. An optical signal converter according to claim 1, wherein said grating waveguide comprises an optical fiber.

7. An optical signal converter according to claim 1, wherein said grating waveguide comprises a planar channel waveguide.

8. An optical encoder for performing binary phase optical encoding for use in an optical code division multiplexing apparatus, comprising:

an optical waveguide grating having an identical number of uniform pitch gratings to the number of code chips of the binary phase optical code, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide to reflect light of a predetermined wavelength,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the light of the predetermined wavelength, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the light of the predetermined wavelength.

9. An optical encoder according to claim 8, wherein the length of said uniform pitch gratings and the spacing between said uniform pitch gratings are determined such that said respective uniform pitch gratings provide substantially the same light propagation delay time.

10. An optical encoder according to claim 8, wherein said optical waveguide comprises an optical fiber.

11. An optical encoder according to claim 8, wherein said optical waveguide comprises a planar channel waveguide.

12. An optical decoder for decoding an optical code division multiplexed optical signal by binary phase optical encoding, comprising:

an optical waveguide grating having an identical number of uniform pitch gratings to the number of code chips of the binary phase optical code, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide to reflect the optical code division multiplexed optical signal,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the optical code division multiplexed optical signal, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the optical code division multiplexed optical signal.

13. An optical decoder according to claim 12, wherein said optical waveguide comprises an optical fiber.

14. An optical decoder according to claim 12, wherein said optical waveguide comprises a planar channel waveguide.

15. An optical signal converter for use in an optical code division multiplexing apparatus which performs optical code division multiplexing using binary phase optical codes, comprising:

a grating waveguide encoder having an identical number of uniform pitch gratings to the number of code chips of the binary phase optical code, said uniform pitch gratings being formed in the waveguide direction of an optical waveguide through phase shift portions each for optically coupling each of said uniform pitch gratings in series

in the waveguide direction, and said uniform pitch gratings reflecting light of a predetermined wavelength; and

an optical attenuator optically coupled at a dead-end terminal of said grating waveguide encoder,

wherein said phase shift portions corresponding to a position at which the optical code value changes have a phase shift amount equal to $(2m+1)\pi/2$ ("m" is an integer), and the remaining phase shift portions have a phase shift amount equal to $n\pi$ ("n" is an integer).

16. An optical code division multiplexing apparatus for performing optical code division multiplexing using binary phase optical codes, comprising:

at least one optical pulse signal generator for generating an optical pulse signal of a predetermined wavelength; and

at least one grating waveguide encoder having uniform pitch gratings the number of which is identical to the number of code chips for one of the binary phase optical codes associated therewith, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide to reflect the optical pulse signal from the optical pulse signal generator associated therewith, and each of said at least one grating waveguide encoder encoding the optical pulse signal from one of said optical pulse signal generators associated therewith,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the corresponding optical pulse signal, and the remaining adjacent uniform pitch gratings are disposed a spacing

apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the corresponding optical pulse signal.

17. An optical code division multiplexing apparatus according to claim 16, wherein at least one of said optical pulse signal generators generates an optical pulse signal at a pulse period equal to or less than a total duration of a grating waveguide encoder which encodes the optical pulse signal.

18. An optical code division multiplexing apparatus according to claim 16, further comprising an adjuster for adjusting the period of the optical pulse signal generated by at least one of said optical pulse signal generators.

19. An optical code division multiplexing apparatus according to claim 16, wherein said uniform pitch grating has a Bragg wavelength λb which satisfies $\lambda p-\Delta\lambda \leq \lambda b \leq \lambda p+\Delta\lambda$, where λp is the wavelength of the optical pulse signal, and $\Delta\lambda$ is the wavelength corresponding to the inverse of a chip period of the encoded signal.

20. An optical code division multiplexing apparatus according to claim 16, wherein at least one of said optical pulse signal generators generates an optical pulse signal at a period different from the periods of optical pulse signals generated by the remaining optical pulse signal generators.

21. An optical code division multiplexing apparatus according to claim 16, further comprising an optical coupler for combining encoded optical signals reflected from said grating waveguide encoders.

22. An optical code division multiplexing apparatus according to claim 16, wherein said optical waveguide comprises an optical fiber.

23. An optical code division multiplexing apparatus according to

claim 16, wherein said optical waveguide comprises a planar channel waveguide.

24. An optical code division demultiplexing apparatus for demultiplexing a multiplexed optical pulse signal which is optical code division multiplexed using binary phase optical encoding, said apparatus comprising:

at least one grating waveguide decoder having uniform pitch gratings the number of which is identical to the number of code chips of a binary phase optical code associated therewith, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide and reflecting the multiplexed optical pulse signal to generate a decoded optical signal; and

at least one optical detector for detecting the decoded optical signal from said at least one grating waveguide decoder, respectively,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the multiplexed optical pulse signal, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the multiplexed optical pulse signal.

25. An apparatus according to claim 24, wherein said optical waveguide comprises an optical fiber.

26. An apparatus according to claim 24, wherein said optical waveguide comprises a planar channel waveguide.

27. An optical code division multiplexing apparatus for performing

optical code division multiplexing using binary phase optical codes, comprising:

a plurality of grating waveguide encoders each having an identical number of uniform pitch gratings to the number of code chips of a binary phase optical code associated therewith, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide to reflect an input optical signal, and each of said plurality of grating waveguide encoders encoding the input optical signal; and

at least one delay element for delaying respective encoded signals from said plurality of grating waveguide encoders relative to one another,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the input optical signal, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the input optical signal.

28. An optical code division multiplexing apparatus according to claim 27, wherein each of said grating waveguide encoders comprises an optical fiber grating.

29. An optical code division multiplexing apparatus according to claim 27, wherein said at least one delay element delays the respective encoded signals from said plurality of grating waveguide encoders relative to one another by a time corresponding to an integer multiple of a chip period of the optical codes.

30. An optical code division multiplexing apparatus according to claim 27, wherein said at least one delay element delays the respective encoded signals from said plurality of grating waveguide encoders relative to one another by a time corresponding to a data rate of the input optical signal divided by an integer.

31. An optical code division multiplexing apparatus according to claim 27, further comprising an optical coupler for combining the delayed encoded signals.

32. An optical code division multiplexing apparatus according to claim 27, wherein each of said plurality of grating waveguide encoders comprises an optical attenuator optically coupled to a terminal end thereof.

33. An optical code division multiplexing apparatus according to claim 27, wherein said uniform pitch gratings have a Bragg wavelength λb which satisfies $\lambda p-\Delta\lambda \leq \lambda b \leq \lambda p+\Delta\lambda$, where λp is the wavelength of the optical pulse signal, and $\Delta\lambda$ is the wavelength corresponding to the inverse of a chip period of the encoded signal.

34. An optical code division multiplexing communication apparatus for performing an optical code division multiplexing using binary phase optical codes, comprising:

a plurality of optical pulse signal generators each for generating an optical pulse signal of a predetermined wavelength;

a plurality of grating waveguide encoders, each having an identical number of uniform pitch gratings to the number of code chips of a binary phase optical code associated therewith, said uniform pitch gratings being formed in a waveguide direction of an optical waveguide to reflect the optical pulse signal, and each said

grating waveguide encoder encoding the optical pulse signal from one of said optical pulse signal generators; and

at least one delay element for delaying respective encoded signals from said plurality of grating waveguide encoders relative to one another,

wherein adjacent uniform pitch gratings corresponding to a position at which the optical code value changes are disposed a spacing apart from each other to give a phase shift of $(2m+1)\pi/2$ ("m" is an integer) to the optical pulse signal, and the remaining adjacent uniform pitch gratings are disposed a spacing apart from each other to give a phase shift of $n\pi$ ("n" is an integer) to the optical pulse signal.

35. An optical code division multiplexing communication apparatus according to claim 34, wherein said grating waveguide encoders each comprise an optical fiber grating.

36. An optical code division multiplexing communication apparatus according to claim 34, wherein said at least one delay element delays the respective encoded signals from said plurality of grating waveguide encoders relative to one another by a time corresponding to an integer multiple of a chip period of the optical codes.

37. An optical code division multiplexing communication apparatus according to claim 34, wherein said at least one delay element delays the respective encoded signals from said plurality of grating waveguide encoders relative to one another by a time corresponding to a data rate of the input optical signal divided by an integer.

38. An optical code division multiplexing communication apparatus according to claim 34, wherein at least one of said optical pulse

signal generators generates an optical pulse signal at a pulse period equal to or less than a total duration of said grating waveguide encoders.

39. An optical code division multiplexing communication apparatus according to claim 34, further comprising an optical coupler for combining the delayed encoded signals.

40. An optical code division multiplexing communication apparatus according to claim 34, wherein each of said plurality of grating waveguide encoders comprises an optical attenuator optically coupled to a terminal end thereof.

41. An optical code division multiplexing communication apparatus according to claim 34, wherein said uniform pitch gratings have a Bragg wavelength λb which satisfies $\lambda p-\Delta\lambda \leq \lambda b \leq \lambda p+\Delta\lambda$, where λp is the wavelength of the optical pulse signal, and $\Delta\lambda$ is the wavelength corresponding to the inverse of a chip period of the encoded signal.